ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

# The Nature Conservancy's Emiquon Preserve

## Fish and Aquatic Vegetation Monitoring

## 2017 Field Report

Olivea M. Mendenhall and Levi E. Solomon

INHS Technical Report: 2018 (33)
Prepared for: The Nature Conservancy
Prepared by: Illinois Natural History Survey
Issue Date: 10/3/2018

Floodplain restoration monitoring of the aquatic vegetation and fish communities of The Nature Conservancy's Emiquon Preserve 2017

Grant/Contract number: The Nature Conservancy CO7-33


University of Illinois at Urbana Champaign
Mark R. Ryan, Executive Director
Prairie Research Institute
Eric M. Schauber, Director
Illinois Natural History Survey
1816 South Oak Street
Champaign, IL 61820
217-333-6830

# Disclaimer

Under contract with The Nature Conservancy (TNC), fish and aquatic vegetation monitoring (2007-present) was conducted on Thompson and Flag lakes of the Emiquon Preserve by the Illinois Natural History Survey, Illinois River Biological Station (INHS-IRBS) in order to evaluate a series of key ecological attributes (KEA) relevant to restoration success. This report presents a summary of data collected for the 2017 field season with trends from previous years. The findings, conclusions, and views expressed herein are those of the researchers and should not be considered as the official position of TNC or the INHS.

# Table of Contents

# Executive Summary

**Overall conclusion:**

For the 2017 field season, The Emiquon Preserve continues to maintain a healthy population of fish with a continual dominance of native fish. Native submersed aquatic vegetation (SAV) is still abundant even though non-native SAV exceeds the established goal. There is little indication currently that non-native species are becoming dominant or degrading environmental conditions. Of 19 relevant Key Ecological Attributes (KEA), 15 were evaluated and four were not measured. Of the 15 KEA's measured, ten goals were met and five were not met in 2017 through standardized monitoring of the fish and aquatic vegetation communities.

**Detailed conclusions:**

*Vegetation Indicators:*

Of the five KEA's measured in 2017 to evaluate submerged and emergent/floating-leafed aquatic vegetation, four goals were met and one was not met. KEA's for SAV assess underwater irradiance, hydrology, and community composition; for emergent/floating leaved vegetation hydrology and community composition were measured.

- Water transparency: mean Secchi disk reading met the desired goal in all years except 2012 and wasn't measured in 2016, however Secchi disk readings met the desired range 59% of the time from June-August and 67% over the 2017 sampling season. The average Secchi disk transparency was 84.33 cm.
- Water depth: water levels rose only 4% of the time and did not exceed 1 m total during the growing season.
- Community composition exceeded the desired range due to non-native Eurasian watermilfoil which comprised of 21% of vegetation collected.
- No non-native emergent, non-rooted floating-leaved, and rooted floating-leaved aquatic vegetation was observed.

*Fish Indicators:*

Out of the 14 goals established for the 2017 evaluations of the fish community, six were met, four were not met, and four were not measured.

- Four new species of fish were detected in 2017 that included black buffalo (*Ictiobus niger)*, river shiner (*Notropis blennius)*, yellow bass (*Morone mississippiensis)*, and invasive silver carp (*Hypophthalmichthys molitrix)*. A total of six silver carp were collected, two during electrofishing and four as bycatch (bycatch numbers are not included in calculations). Since 2007, the number of native species sampled in a single year has never met the goal of 25 or more, however 31 species have been collected cumulatively since 2007.
- The number of native fish and their biomass continue to dominate non-native fish comprising of 99.7% of the number of fish and 91.6% of the biomass collected. Non-native fish represented less than 1% of the community but made up 7.7% of the biomass.
- Native predatory fish population (catch-per-unit-effort (CPUE) of largemouth bass (*Micropterus salmoides*) was 41 fish/hr., which is considered a poor CPUE. Bowfin (A*mia calva*) remain present during sampling. Other predatory fish have been present during sampling events such as: spotted gar (*Lepisosteus oculatus*) and shortnose gar (*Lepisosteus platostomus*).
- Dissolved oxygen levels continue to exceed the minimum levels required by fish during spawning though there is a slight decline since last year.
- Although large woody debris is minimal, shading is often provided by abundant aquatic vegetation.
- Water was released during August, where water flowed for 50 days, this allowed for a reduction of 2.81 feet asl. Fish passage was prevented using screens when releasing water thereby not allowing accessibility of riverine fish to enter Emiquon for nursery purposes. Secondary production to the Illinois River was not measured.
- No young-of-year (YOY) desired species e.g. freshwater drum (*Aplodinotus grunniens)*, goldeye (*Hiodon alosoides)*, bigmouth buffalo (*Ictiobus cyprinellus)* were collected however, adult freshwater drum, black buffalo, and bigmouth buffalo were collected. Native fish made up the bulk of the YOY fish with only two non-native YOY (common carp, *Cyprinus carpio*) found.

- Relative weights for largemouth bass declined but remain in the desired range, other sportfish such as bluegill (*Lepomis machrochirus*), pumpkinseed (*Lepomis gibbosus*), and black crappie (*Pomoxis nigromaculatus*) showed increases in 2017.
- Aquatic vegetation was found 88% of the time in littoral areas and is above the desired range of 25-40%, we still consider this KEA goal as being met since it provides shallow water habitat.
- No over wintering sampling was conducted in 2017.

# Introduction

Historically, the backwaters that make up the Emiquon Preserve were among the most productive backwater lakes in the Illinois River Valley (IRV). Both lakes were disconnected from the Illinois River and reduced to agricultural drainage ditches by the 1930's and both lakes remained drained and in continuous agricultural production, becoming one of the largest farms in Illinois, until 2006. The Nature Conservancy (TNC) purchased this property in 2000 and began aquatic restoration in 2007. As a part of the restoration, the surrounding levees were left in place, but the drainage of accumulating water was discontinued, and the drainage ditches were treated with rotenone to limit the risk from any non-native common carp (*Cyprinus carpio*) that were living in the ditches. The preserve was allowed to naturally fill through precipitation and >30 native fish species were stocked by Illinois Department of Natural Resources (IDNR) based on historical records of both lakes (VanMiddlesworth et al. 2016, Havera et al. 2003). The staff of the Illinois Natural History Survey's, Illinois River Biological Station has been monitoring the submerged aquatic vegetation (SAV) and fish assemblages from 2007 to the present. The data collected is used to evaluate Key Ecological Attributes (KEAs) of restoration success. The 19 KEA's assessed in this report were developed in 2004 by the Emiquon Science Advisory Council (i.e. The Nature Conservancy and partners) to serve as the driving management tool for the Emiquon Restoration. The knowledge gained may aid in future management efforts at the Emiquon Preserve and other floodplain restoration efforts.

# Methods

*Submersed Aquatic Vegetation*

Samples were collected in August in 2017 at 30 sites that were randomly selected throughout Thompson and Flag lake using cover mapping data collected by Forbes Biological Station. Using the cover mapping data, random points were generated in ArcMap within the aquatic bed community. A visual assessment was conducted in a 1 $m^2$ area and a sub-sample was taken within the area using a box sampler (41,760 $cm^3$ area). Samples were collected, placed in a Ziploc style bag, and returned to the laboratory to be frozen until samples could be processed. In the laboratory, the micro and macro invertebrates and seeds were rinsed off, each sample was then sorted and identified to species. Each species within a sample was placed in a weighing boat and weighed to obtain a wet weight. The weighing boat was then placed in a drying oven for 16-48 hours at ≥ 60 °C and weighed again to obtain dry weight.

*Fish Monitoring*

Monthly fish sampling was conducted from April to October annually using a multiple gear approach at random and fixed sites. Sampling gear types include: pulsed-DC electrofishing (15 minutes of effort per site), fyke netting (~24 hours each), and mini-fyke netting (~24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Fixed sites were located on east side of Thompson Lake for the fyke and mini-fyke nets with the electrofishing site located in the pumphouse ditch between Thompson and Flag Lake. Other sampling sites were selected randomly within Thompson Lake and all gears were fished according to the LTRM fish monitoring protocols found in Ratcliff et al. (2014).

# Sampling Effort (2007-2017)

*Submersed Aquatic Vegetation*

In 2016, vegetation sampling changed methodologies and implemented the box sampler method to obtain a more accurate measurement of biomass. Sample sites were randomly selected throughout Thompson and Flag Lake using cover mapping data collected by Forbes Biological Station. Using this information, random points were generated in ArcMap within the aquatic bed community. A visual assessment was conducted in a 1 $m^2$ area and a subsample was taken within

the area using a box sampler (41,760 cm³ area). Samples were returned to the laboratory and frozen until process. Samples were identified to species except for unknown species that consisted of stems or pieces. In 2016 a total of 20 sub samples were collected in mid-September and 30 sub-samples were collected in 2017 in mid-August.

From 2010-2015, submersed aquatic vegetation density was estimated by percent coverage on a vegetation rake, while emergent, non-rooted floating-leaved, and rooted floating-leaved aquatic vegetation density is estimated by percent cover observed within a 2 m perimeter around the boat. All aquatic vegetation data were collected according to the U.S. Army Corps of Engineers' Upper Mississippi River Restoration (UMRR) Program's Long Term Resource Monitoring element (LTRM) aquatic vegetation monitoring protocols of Yin et al. (2000). Aquatic vegetation was sampled from May-September at both Thompson and Flag lake, which were sampled as one water body, but spatially stratified into north, middle, and south units. The number of sites sampled per unit was proportional to the surface area of each unit and was determined monthly. Sampling was conducted at 30 random sites each month during May, June, and September but at 60 random sites each month in July and August, during the peak of the growing season.

Full-scale aquatic vegetation monitoring was not conducted in 2007 to reduce disturbance caused by boat and plant collections to allow establishment of aquatic vegetation during the first year of restoration. However, it should be noted that there was aquatic plant species present at Thompson Lake in 2007 while conducting fish monitoring. During 2008-2009, aquatic vegetation by sampling was monitored using random littoral (<15 m from the shoreline) and pelagic (>15 m from the shoreline) areas at Thompson Lake. Sampling was conducted monthly at five random littoral and pelagic sites each during April-October and at 20 random littoral and pelagic sites each in July during the peak of the growing season. Additionally, three east/west fixed site transects were sampled monthly at seven locations along each transect for aquatic vegetation from May-October. Flag Lake was not sampled from 2007-2009 due to insufficient water levels.

*Fish Monitoring*

Monthly sampling occurred from April-October in 2017 using a multiple gear approach at random and fixed sited. This totaled 28 electrofishing runs (15 minutes each), 28 fyke net sets (~24 hours each), and 28 mini-fyke net sets (~24 hours each) at shoreline or pseudo-shoreline

(used for shoreline gear) sites for the sampling season. In 2016, sampling was limited to July through October due to staff turnover, but the monthly effort and methods were the same as annual effort between 2009 and 2015 except tandem nets were not set in 2015, 2016, 2017.

From 2009-2015 a total of: 28 electrofishing runs (15 minutes each), 28 fyke net sets (~24 hours each), and 28 mini-fyke net sets (~24 hours each) were set at shoreline or pseudo-shoreline (used for shoreline gear) sites. Seven tandem fyke net sets (~24 hours each) and seven tandem mini-fyke net sets (~24 hours each) were deployed at open water (pelagic) sites until use was discontinued due to mortality rates. Minnow traps were discontinued in 2009 because they were a less effective gear than mini-fyke nets. These gear totals were stratified to give a balanced assessment of the major habitats (shoreline, open water, and ditch). All gears were fished according to the LTRM fish monitoring protocols of Ratcliff et al. (2014).

Fish sampling in 2007 and 2008 differed due to water surface elevation at Emiquon. For instance, in 2007 sampling was conducted July-November (excluding September) using a multiple gear approach at fixed sites including: nine pulsed-DC electrofishing runs (15 minutes each), 12 fyke net sets (~24 hours each), 12 mini-fyke net sets (~24 hours each), and 25 minnow trap sets (~24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Also, two tandem fyke net sets (~24 hours each), two tandem mini-fyke net sets (~24 hours each), one trammel net set (1.5-hour set) and one experimental gill net set (1.5-hour set) were deployed at open water (pelagic) sites. By comparison sampling in 2008 was conducted April-October at Thompson Lake using a multiple gear approach at random and fixed sites including: 28 electrofishing runs (15 minutes each), 28 fyke net sets (~24 hours each), 28 mini-fyke net sets (~24 hours each), and 25 monthly minnow trap sets (~24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Seven tandem fyke net sets (~24 hours each) and seven tandem mini-fyke net sets (~24 hours each) were deployed at open water (pelagic) sites. Flag Lake was also sampled with two electrofishing runs (15 minutes each). Gill and trammel nets became fouled by aquatic vegetation and algae in 2007 and were discontinued in 2008.

# Key Ecological Attributes (KEAs) Results for Submersed Aquatic Vegetation

**KEA 1:** Underwater Irradiance

**Indicator:** Secchi disc transparency

**Desired Range:** In submersed aquatic vegetation target areas, where water depth is ≤1.5 m, Secchi disc reading should be ≥ half the maximum water depth during late spring/early summer

**Goal Met: YES**

Met: 2007-2011, 2013-2015, and **2017**

Not met: 2012

Not measured: 2016

**Notes**:

Vegetation samples were collected in mid-August using the box sampler method.

- Secchi disk transparency readings were greater than half the maximum water depth at 25 of the 30 sites.
- The average Secchi readings was 84.33 cm and the average depth was 1.15 m (115 cm).
- Secchi disk readings met the desired KEA range 59% of the time from June – August (Fig 1) and 67% (Fig 2) of the time throughout the sampling year using data collected from fish sampling sites.

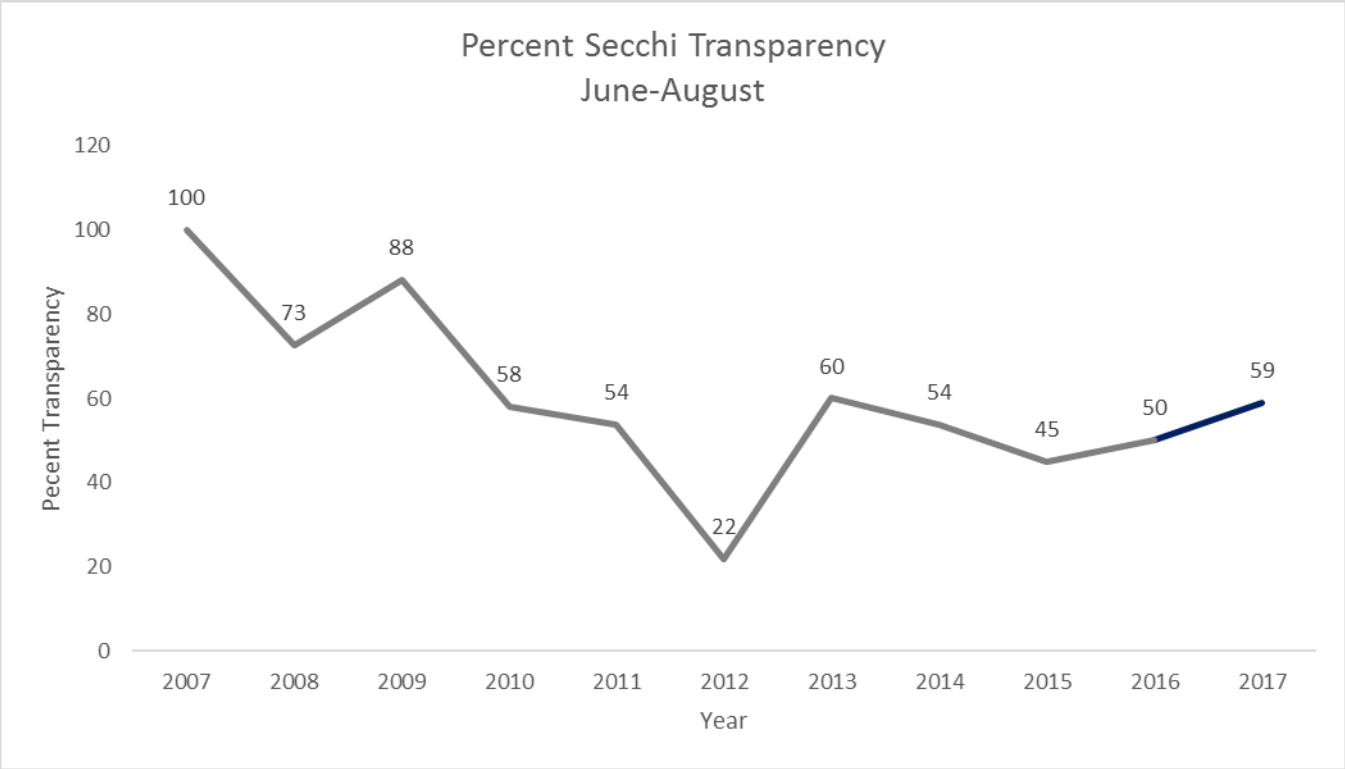


*Figure 1*

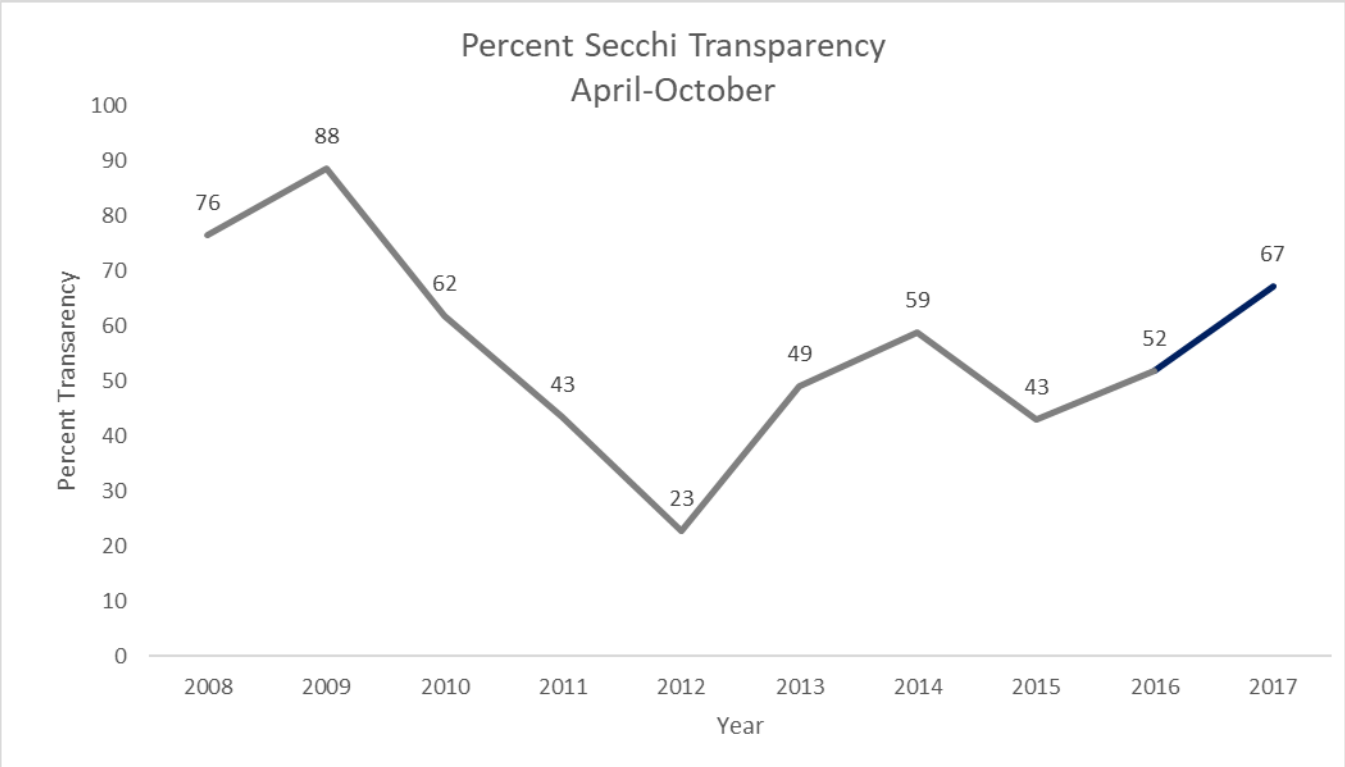


*Figure 2*

**KEA 2:** Hydrology

**Indicator:** Water depth

**Desired Range:** Rate of water rise should not exceed 1.5 cm/day during the growing season (May-September); water level fluctuations (rise) should not exceed 1 m total (May-September)

**Goal Met: YES**

Met: 2007-**2017**

Not met:

Not measured:

Daily water gauge data were collected by TNC from the Emiquon pump house.

- Excluding days where no data was collected or that were not within time period (May-September). The water level rose less than 1.5 cm/day 96% of the time (Fig 3) and the water level did not exceed 1 m in 2017 (Fig 4).

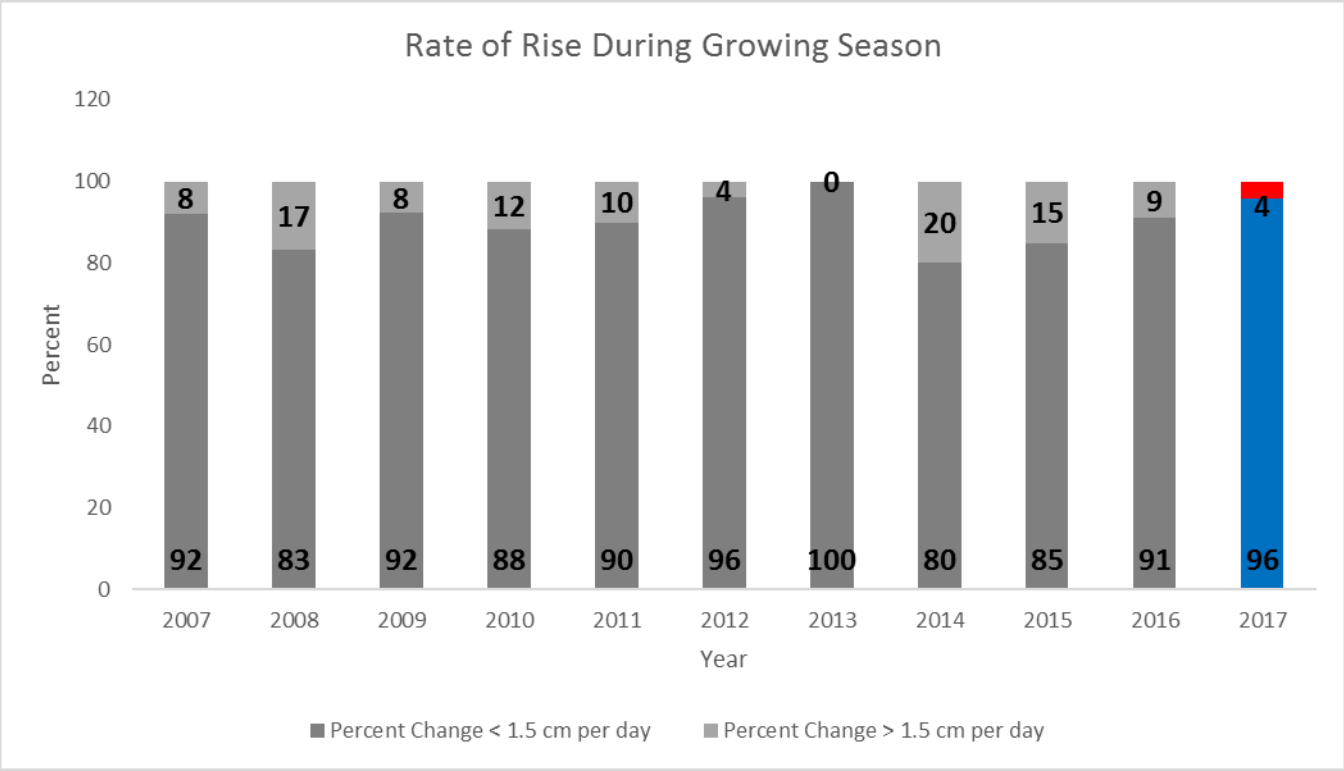


*Figure 3*

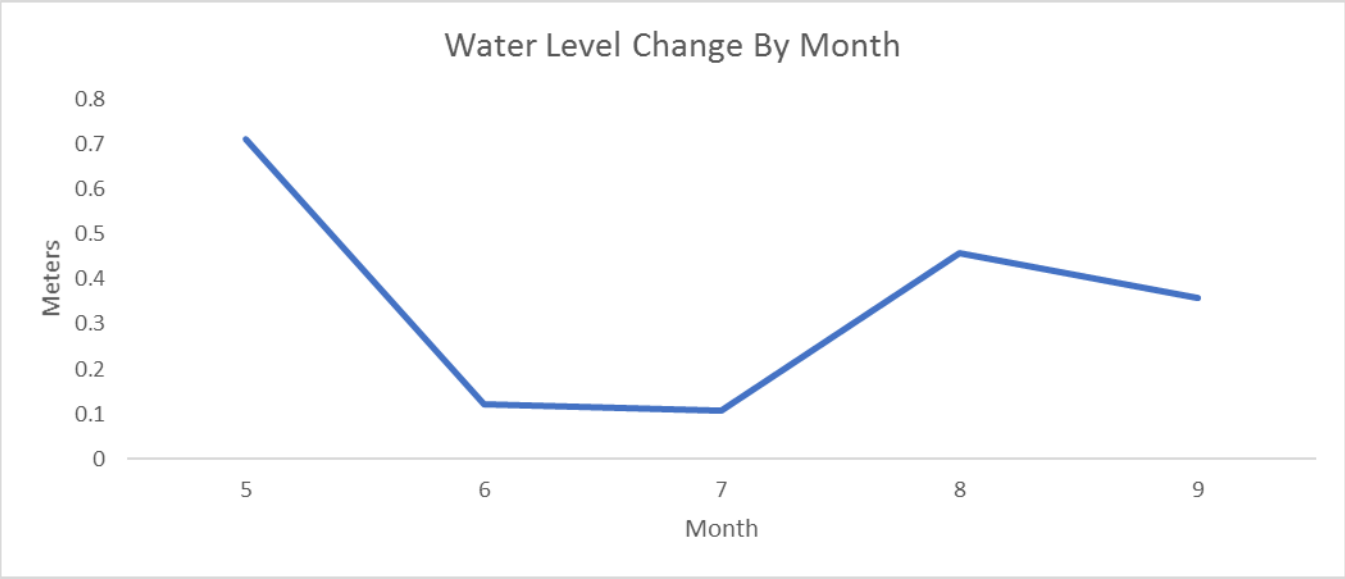


*Figure 4*

**KEA 3:** Community Composition

**Indicator:** Percent natives vs. invasive

**Desired Range:** ≤10% exotics, e.g., Eurasian watermilfoil *Myriophyllum spicatum*, curly-leaf pondweed *Potamogeton crispus*

**Goal Met: NO**

Met: 2008 and 2009

Not met: 2010- **2017**

Not measured: 2007

**Notes**:

Community composition of native verses the percent of non-native (invasive) species was determined by percent abundance of each species using data collected using box sampler method. Samples of vegetation were collected, sorted, and weighed to determine the dry mass of each species in the sample.

- Non-Native species (Eurasian watermilfoil) made up 21% which exceeds the desired range of ≤ 10% and is up 3% from the previous year (Fig 5).
- The unknown species consisted of stem pieces that could not be identified and made up less than 1% of the total.

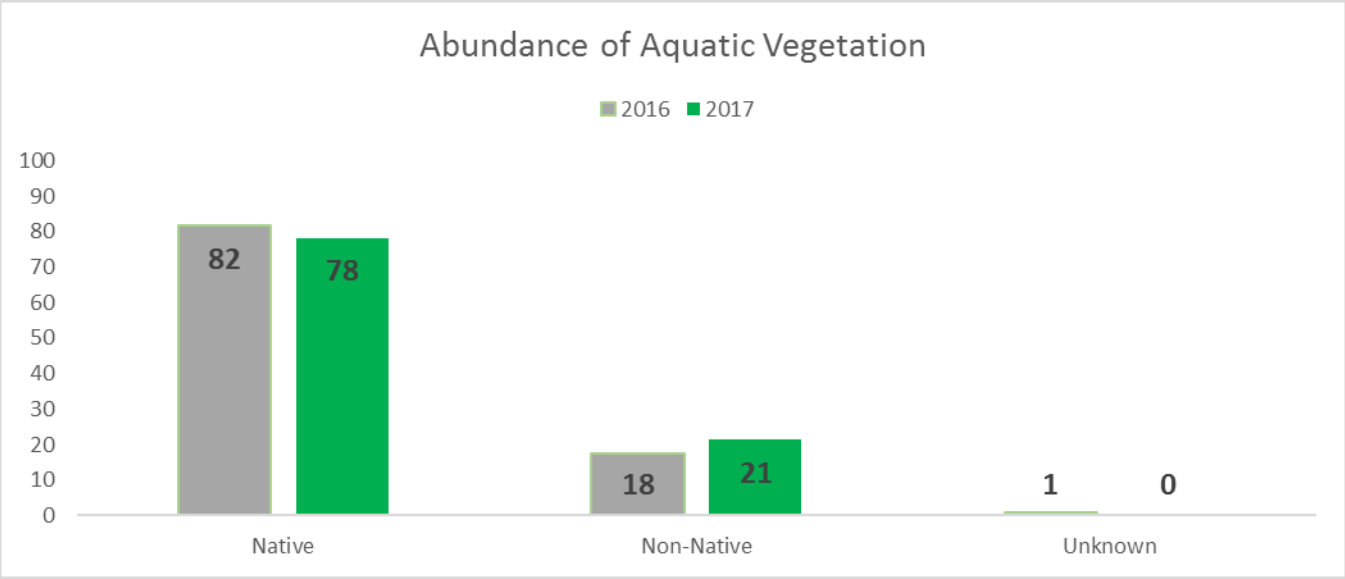
Abundance of Aquatic Vegetation
2016
2017
100
90
80
70
60
50
40
30
20
10
0
82
78
18
21
1
0
Native
Non-Native
Unknown

*Figure 5*

# Key Ecological Attributes (KEAs) Results for Emergent and Floating Leaved Plants

**KEA 4:** Hydrology

**Indicator:** Stable water depth

**Desired Range**: Rate of water rise does not exceed 1.5 cm/day during the growing season (May-September); Water level fluctuations (rise) do not exceed 1 m total (May-September)

**Goal Met: YES**

Met: 2007-**2017**

Not met:

Not measured:

Daily water gauge data were collected by TNC from the Emiquon pump house.

- Excluding days where no data was collected or that were not within time period (May-September). The water level rose less than 1.5 cm/day 96% of the time (Fig 6) and the water level did not exceed 1 m (Fig 7).

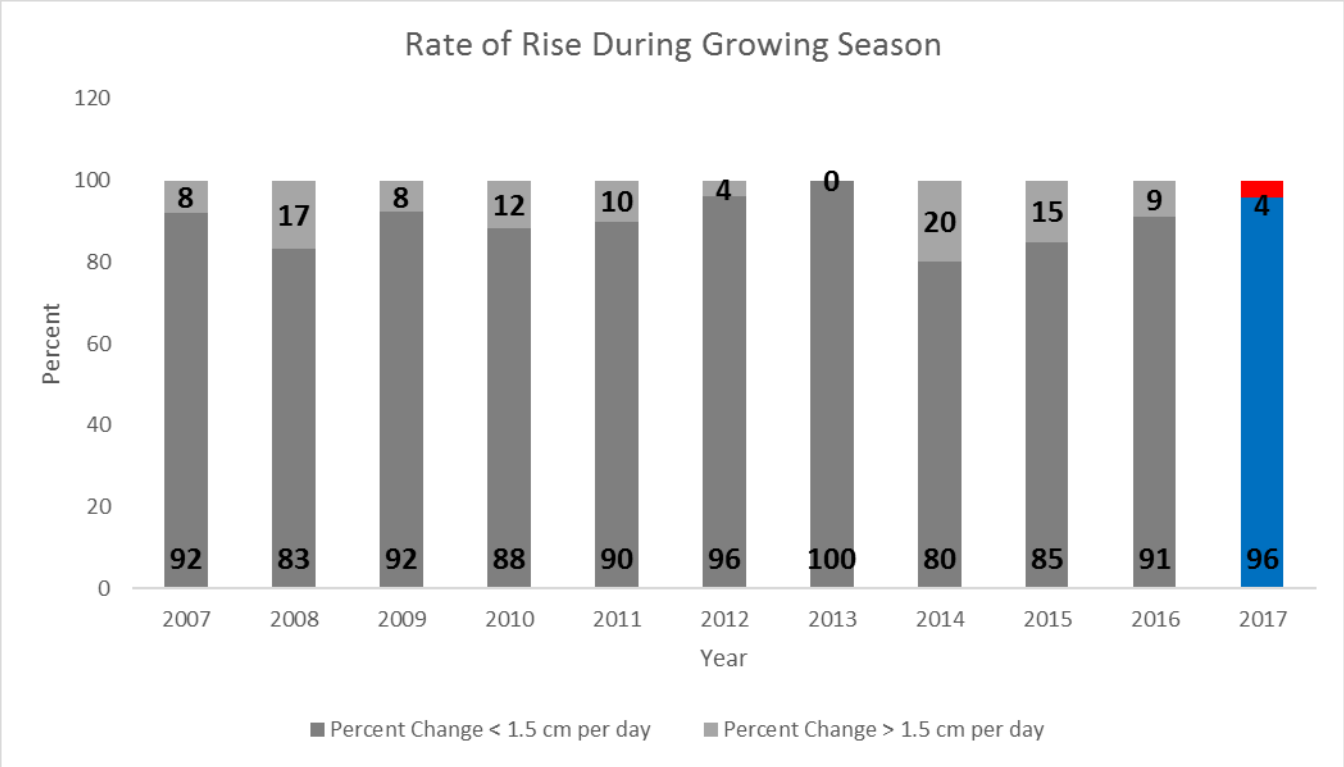


*Figure 6*

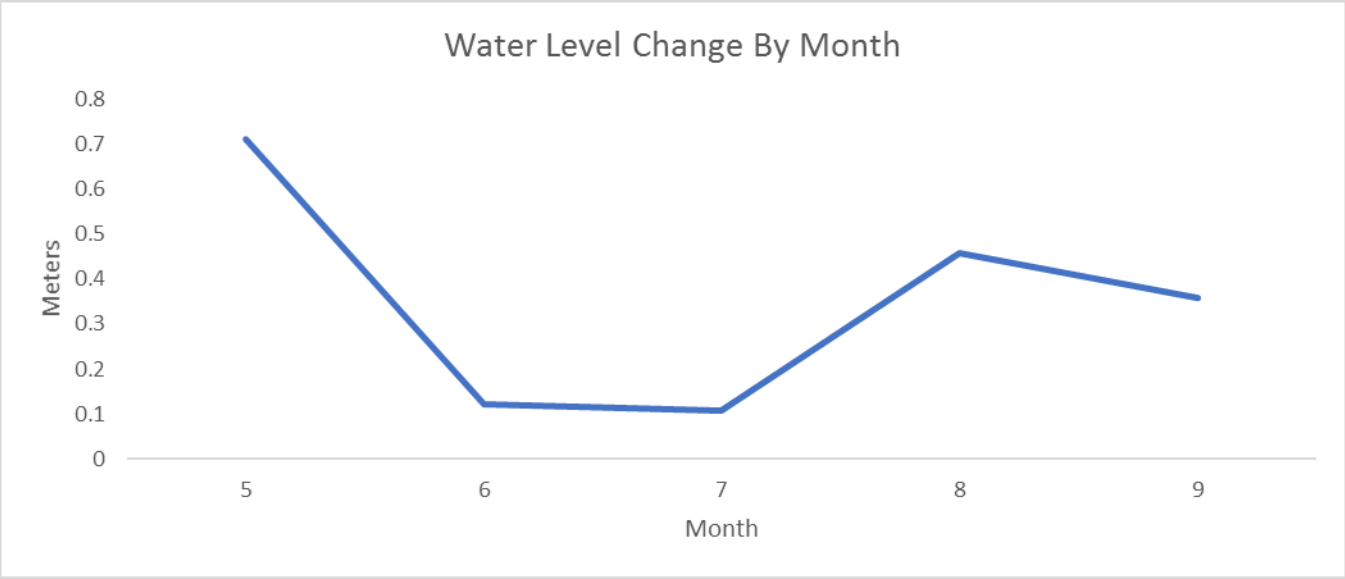


*Figure 7*

**KEA 5:** Community Composition

**Indicator:** Percent natives vs. invasive

**Desired Range:** ≥90% dominance by native species

**Goal Met: YES**

Met: 2008-**2017**

Not met:

Not measured: 2007

**Notes:**

- No non-native emergent, non-rooted floating-leaved, and rooted floating-leaved aquatic vegetation was not observed during 2008-2017.

# Key Ecological Attributes (KEAs) Results for Fish Assemblage

**KEA 6:** Fish Community Assemblage

**Indicator:** Number of native species populations

**Desired Range:** ≥25 native species represented (very good = ≥30 native species)

**Goal Met: NO**

Met:

Not met: 2007-**2017**

Not measured:

**Notes**:

The number of native fish species was calculated by taking the total catch of all fish in all gear types in each year.

- The number of native species present was 23 in 2017 sampling. (Fig 8).
- Since 2007 a total of 31 unique species have been collected.
- Six silver carp were collected, two during electrofishing and four as bycatch. Bycatch is defined as captured outside of standard methods (i.e. jumped in boat). Fish that are collected in bycatch are not used in calculations.

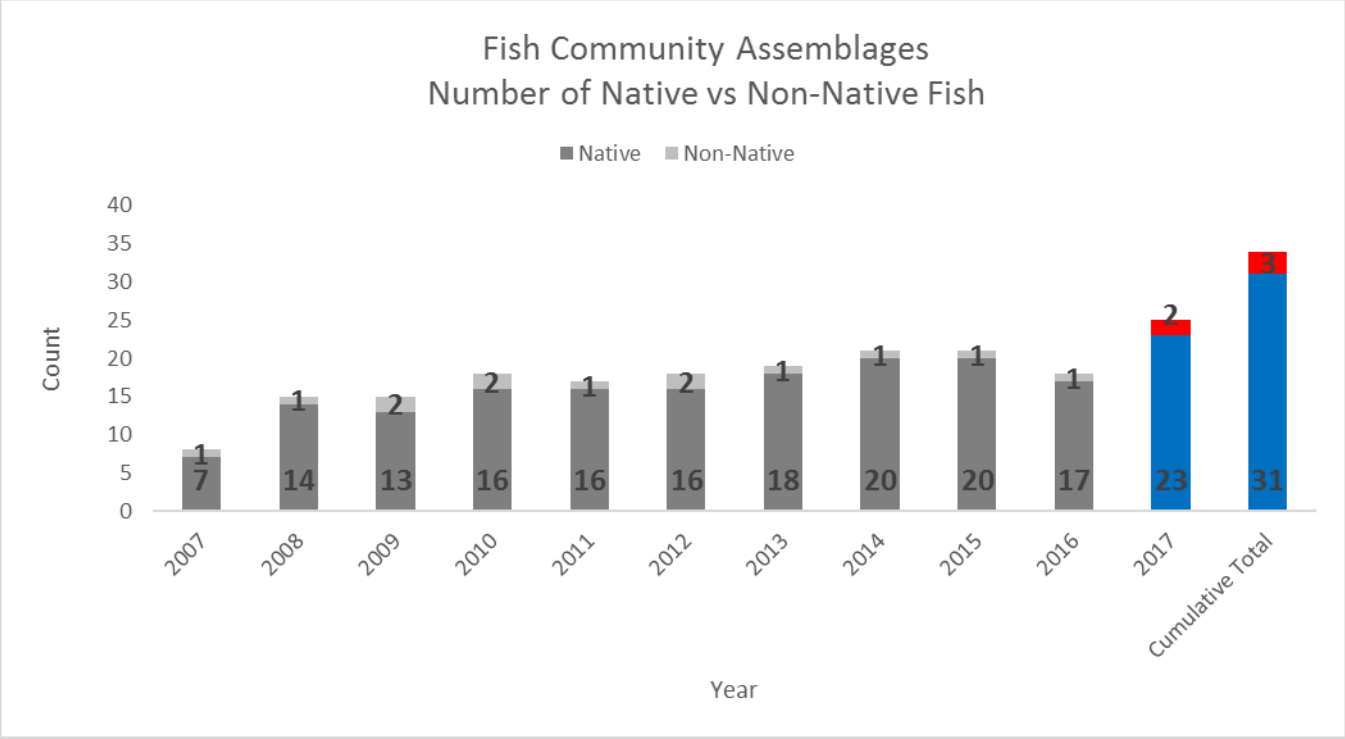


*Figure 8*

**KEA 7**: Fish Community Assemblages

**Indicator:** Number of native species populations

**Desired Range:** Native species ≥50% of number; Native species ≥50% of total biomass

**Goal Met: YES**

Met: 2007-**2017**

Not met:

Not measured:

**Notes**:

The abundance and biomass of native species was calculated using all fish and all gear types.

- Native fish species dominated the fish community in 2017, representing 99.7% of the population and 91.6% of the biomass (Fig 9).
- Non-Native species composed of 0.3% of the fish captured and 7.7% of the biomass.
- Hybrid fish numbers and biomass made up less than 1% consisting of one common carp x goldfish hybrid.

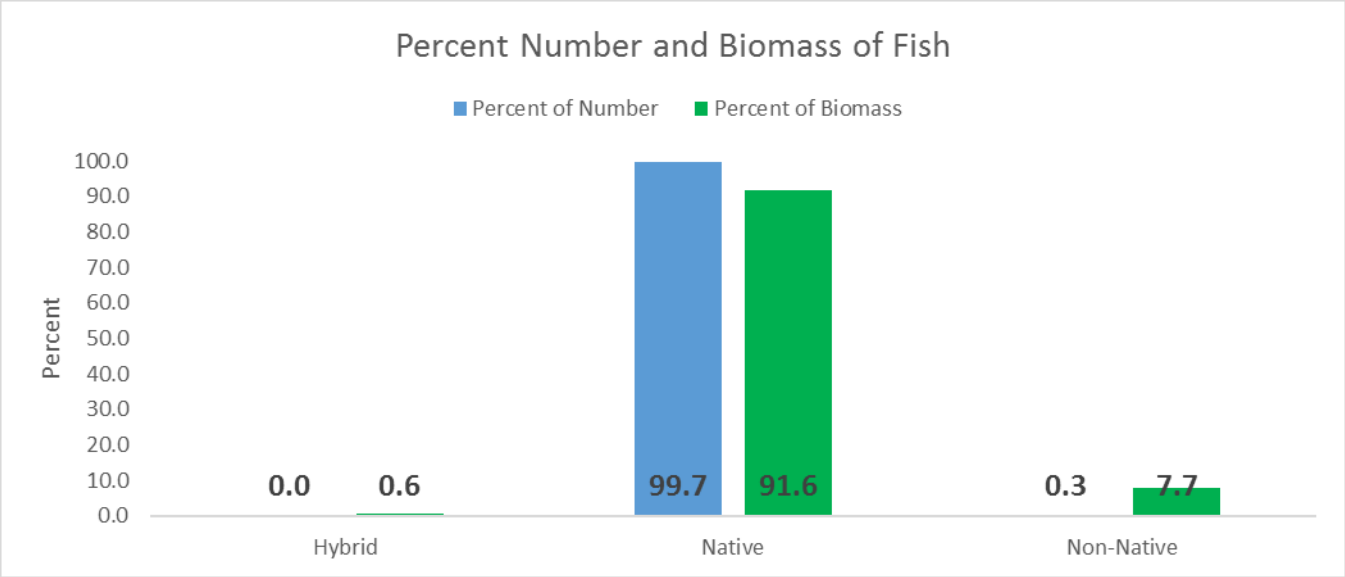


*Figure 9*

**KEA 8:** Fish Community Composition

**Indicator:** Body condition of native predatory fish population

**Desired Range:** Very good = ≥100 largemouth bass (*Micropterus salmoides)* CPUE while electrofishing and bowfin (*Amia calva)* present, good = 75-100 largemouth bass CPUE, fair = 50-75 largemouth bass CPUE, poor = <50 largemouth bass CPUE

**Goal Met: NO, POOR**

Met: (with all types present): 2007 (very good), 2008 (good), 2009 (fair), 2010 (good), 2012 (good), 2013 (fair), 2015 (fair)

Not met: 2011 (poor), 2014 (poor), 2016 (poor), **2017 (POOR)**

Not measured:

**Notes**:

Largemouth bass CPUE was calculated using only day electrofishing.

- The mean CPUE for largemouth bass was calculated to be 41 which is considered to be poor (Fig 10).
- The Bowfin criteria, annual determination of presence or absence, was assessed from electrofishing data and were present in 2017 sampling.
- Additionally, other predatory fish (i.e. gar spp.) were also collected in every year except 2007.

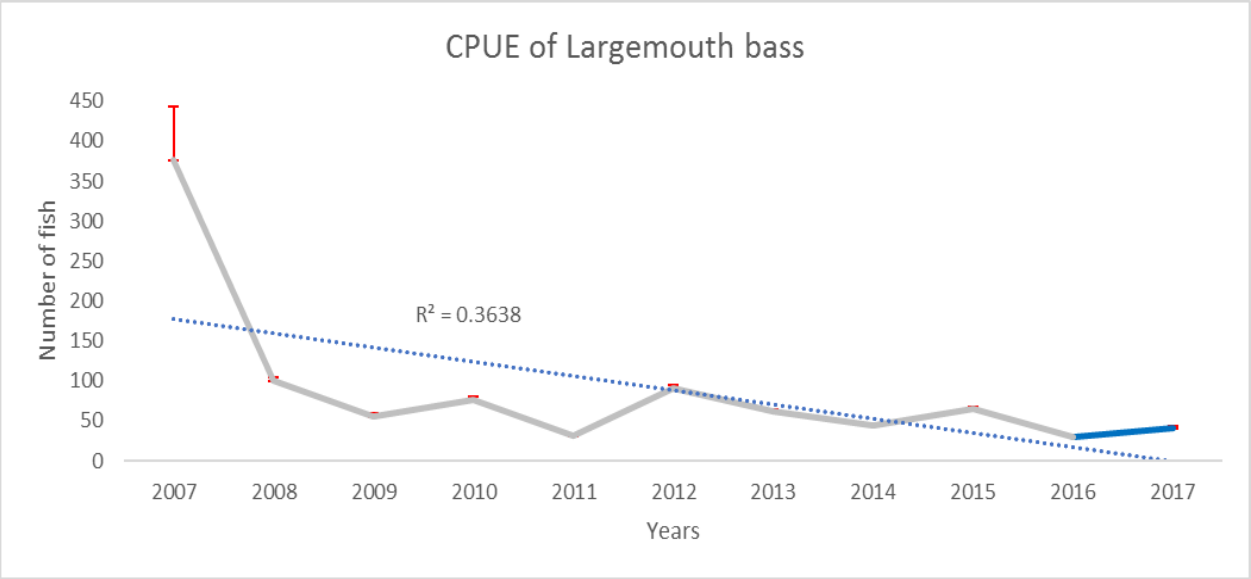


*Figure 10 (grey indicates prior years and blue indicates 2017 Largemouth bass CPUE)*

**KEA 9:** Spawning

**Indicator:** Water dissolved oxygen

**Desired Range:** 4 ppm oxygen (very good = ≥5 ppm and <200% saturation oxygen)

**Goal Met: YES, Not Measured**

Met: 2007-**2017**

Not met:

Not measured: <200 % Saturation oxygen not measured from 2007-**2017**

**Notes**:

Fish and vegetation sites were each calculated separately using only sites in which dissolved oxygen was measured.

- Mean monthly (April-October) dissolved oxygen concentrations collected from all aquatic vegetation and fish sampling sites above the desired range in 2017 however, percent saturation was not measured in any year (Fig 11).
- Vegetation collection after 2015 used the box sampler method and the number of sample sites was lower than prior when LTRM rake method was used so less dissolved oxygen readings were taken 2016-2017 than previous years.

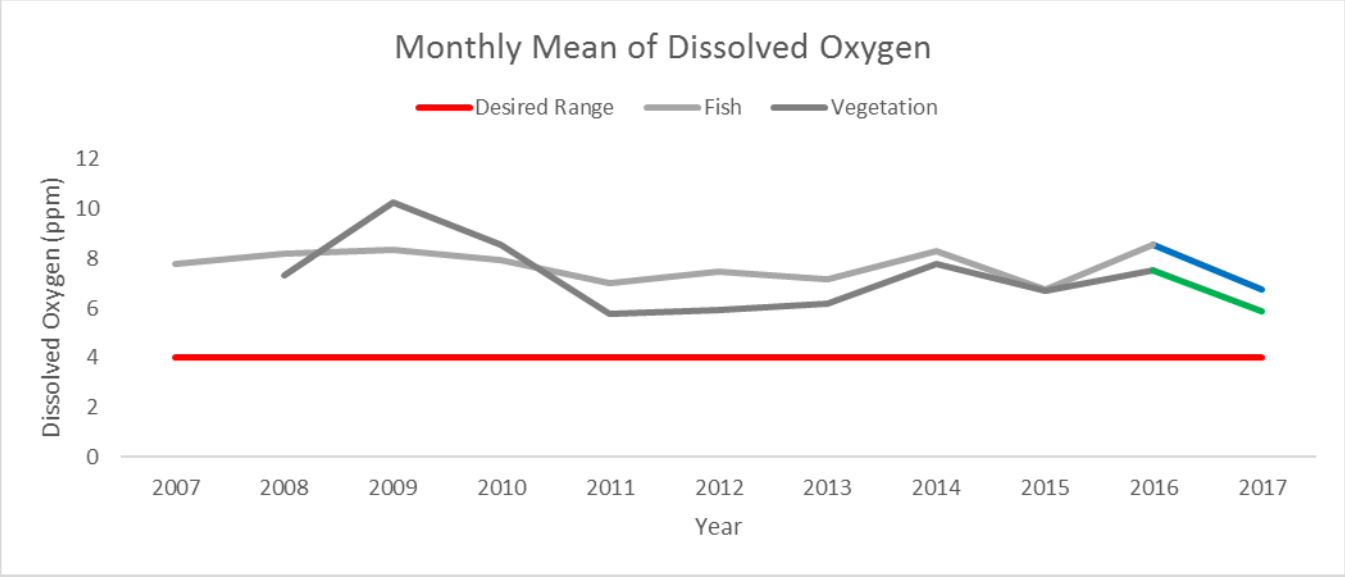


*Figure 11 (dark grey of vegetation indicates years using LTRM rake method, light grey indicates the box sampler, and green is 2017 sampling season. Mid grey is previous years of fish sampling and blue is 2017 sampling season.)*

**KEA 10:** Spawning

**Indicator:** Substrate variability and structure (large woody debris)

**Desired Range:** Subset representing several of the following types present: diverse shoreline, shade, fallen trees, open areas, and submerged plants (very good = all types present)

**Goal Met: YES**

Met: 2007-**2017**

Not met:

Not measured:

**Notes**:

- We noted the presence of several aquatic plant beds (mostly submersed and some emergent), along with minimal shoreline habitat diversity, open areas, large woody debris, and shade while conducting fish monitoring in 2017.
- There was an abundance of diverse shoreline habitats, open areas, as well as submersed, emergent, non-rooted floating-leaved, and floating-leaved aquatic vegetation from 2008-2017.
- Large woody debris and shading provided by them was minimal during these years, but shade was made abundant by aquatic vegetation.

**KEA 11:** Spawning

**Indicator:** Frequency of April/May connection to the river

**Desired Range:** Every three years for long-lived species, more frequently for short-lived species (very good = annual connection)

**Goal Met: NO**

Met: 2013, 2015

Not met: 2007-2012, 2014, 2016, and **2017**

Not measured:

**Note**s:

- The Emiquon Preserve was disconnected from the Illinois River during 2007-2016 except in 2013 when the levee was overtopped by flood waters.
- In 2016 the water control structure (WCS) became operational allowing TNC to manage water levels inside Emiquon. Passage of undesirable/invasive species was prevented by

screens inside the WCS that prevented fish passage between Emiquon and the Illinois River.

- Water was released late in the year (August-October) and was not released during April or May of 2017 from the WCS.

**KEA 12:** Nursery

**Indicator:** Accessibility for riverine fish

**Desired Range:** Presence of YOY freshwater drum, goldeye, bigmouth buffalo (very good = all of the above plus paddlefish *Polyodon spathula*)

**Goal Met: NO**

Met: 2013

Not met: 2007-2012, 2014-2016, and **2017**

Not measured:

**Notes**

- No YOY freshwater drum, goldeye, or bigmouth buffalo were present in the 2017 sampling season.
- Adult fresh water drum, black buffalo, and bigmouth buffalo were collected.

**KEA 13:** Nursery

**Indicator:** Native fish larvae

**Desired Range:** Dominance of native species

**Goal Met: YES**

Met: 2007-**2017**

Not met:

Not measured:

**Notes:**

All fish were considered young-of-the-year (YOY) if they measured less than 100 mm in length.

- Of the 639 YOY fish collected, two non-native YOY common carp were present in 2017.

**KEA 14:** Feeding

**Indicator:** Presence of adults in good body condition

**Desired Range:** Mean relative weights 90-110%

**Goal Met: YES**

Met: 2007-**2017**

Not met:

Not measured:

**Notes:**

Mean relative weight ($W_r$) for largemouth bass, bluegill, pumpkinseed, black crappie was calculated following methods outlined in the third edition of Fisheries Techniques (Neumann et al. 2012) and used a modified Z score to remove outliers following methods outlined by Pendleton et al. (2017).

- Mean relative weight for largemouth bass declined slightly from the previous year but remains above the minimum threshold (Fig 12).
- Bluegill, pumpkinseed, and black crappie relative weights all showed increases in relative weight from 2016 despite declining since 2007 (Figs 13, 14, 15).

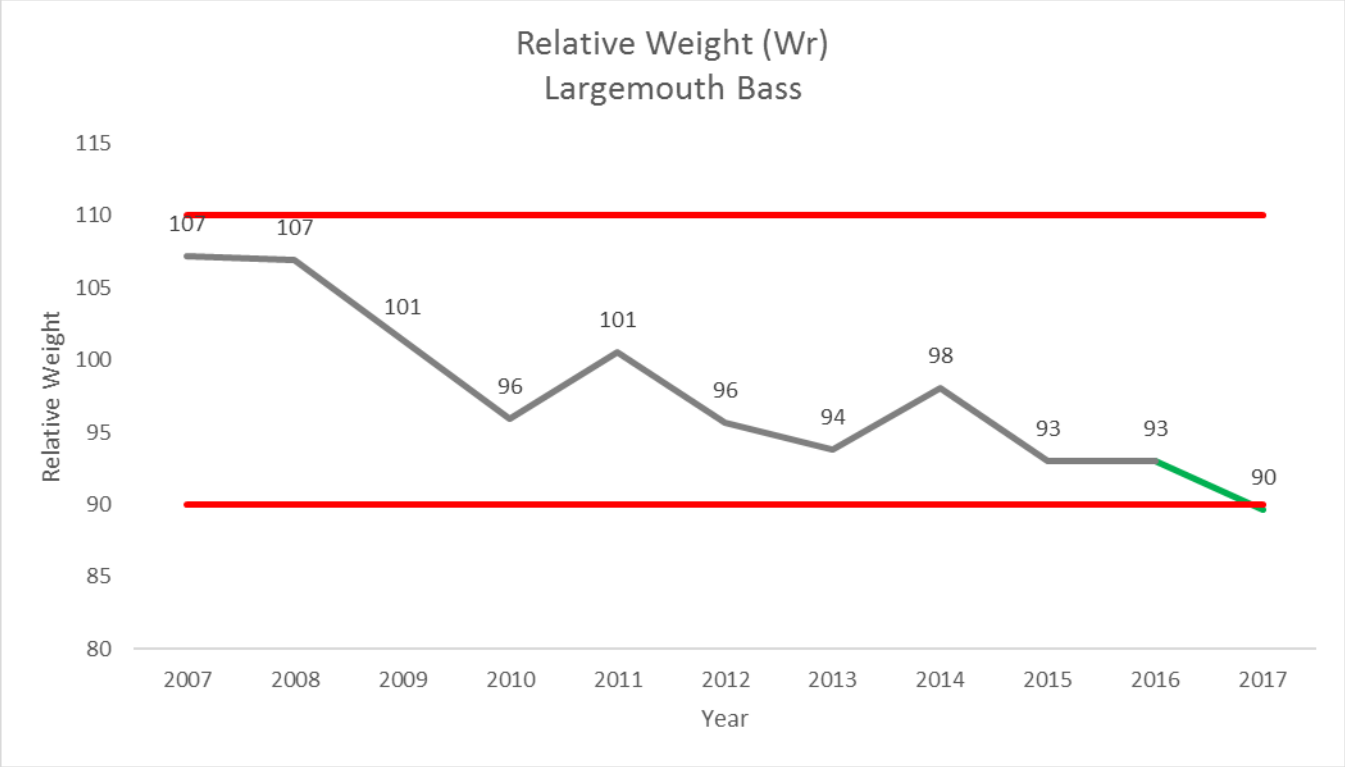


*Figure 12*

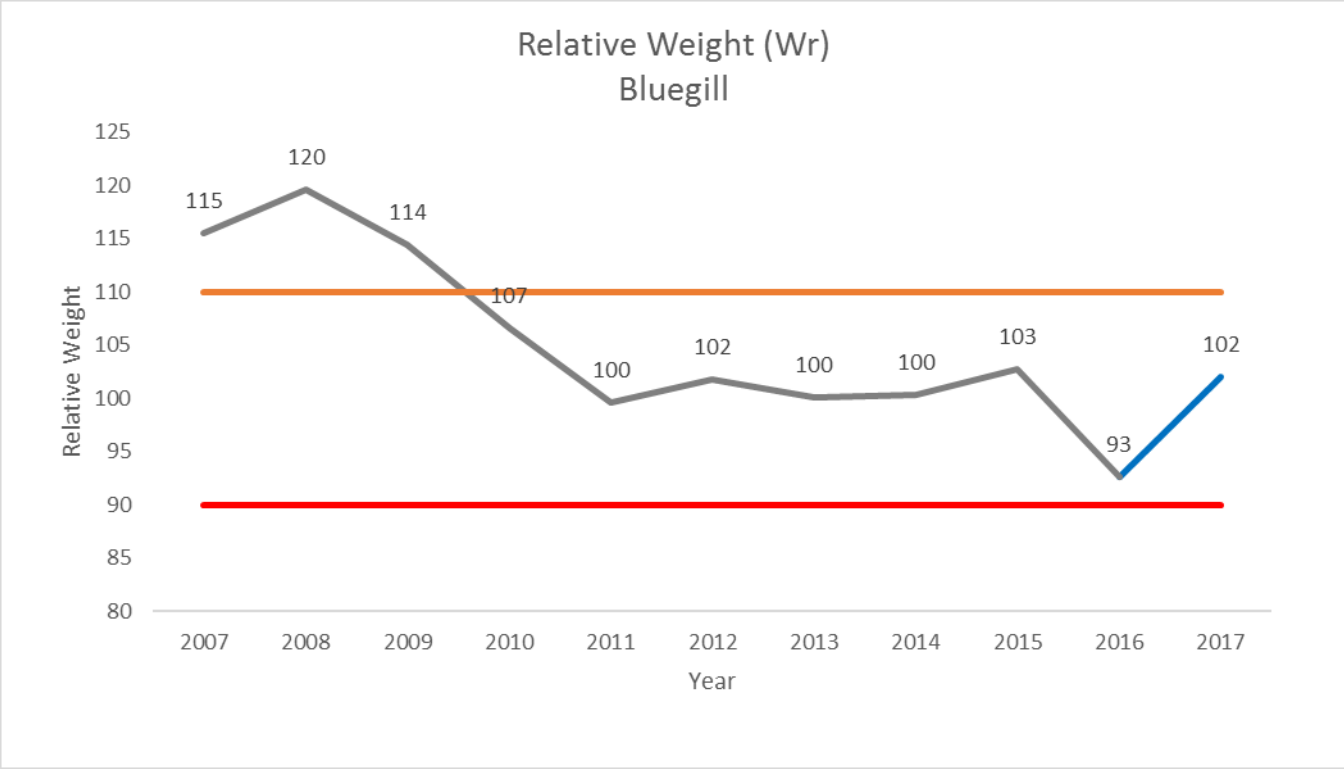


*Figure 13*

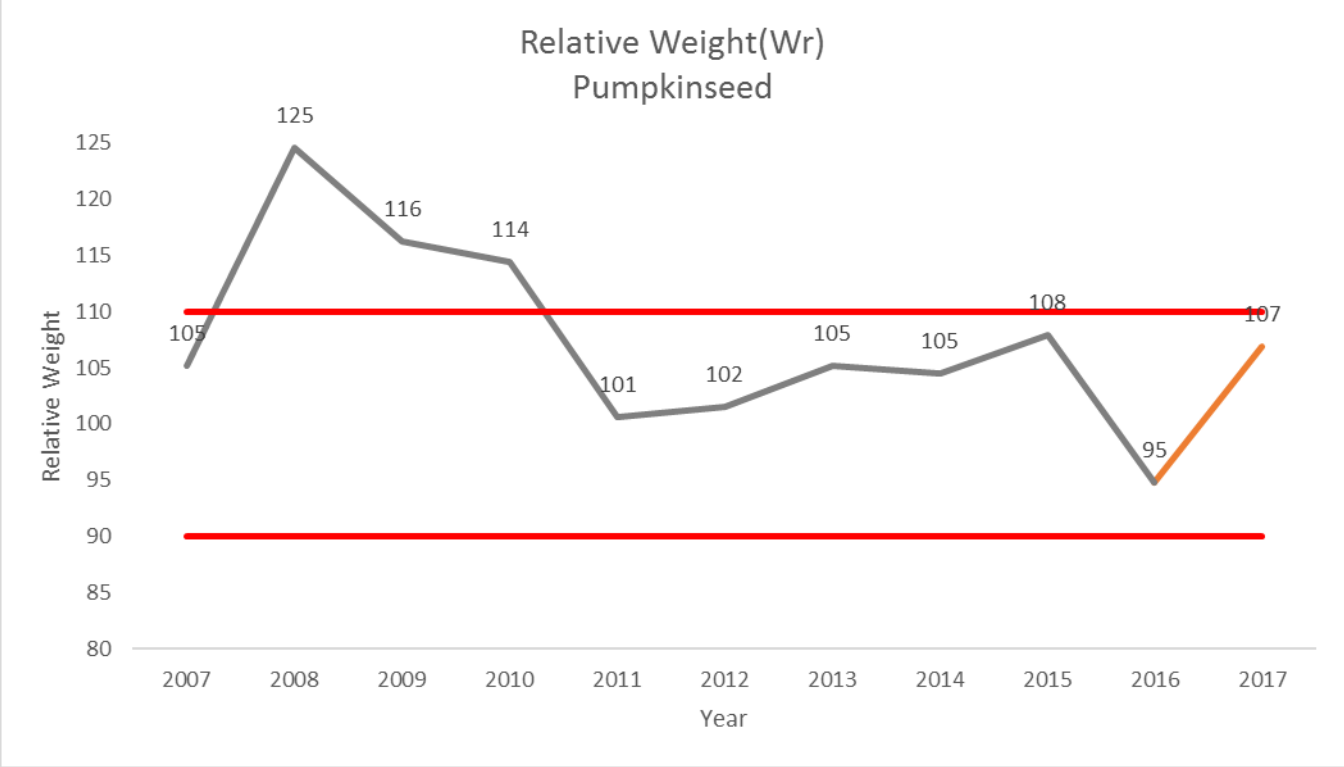


*Figure 14*

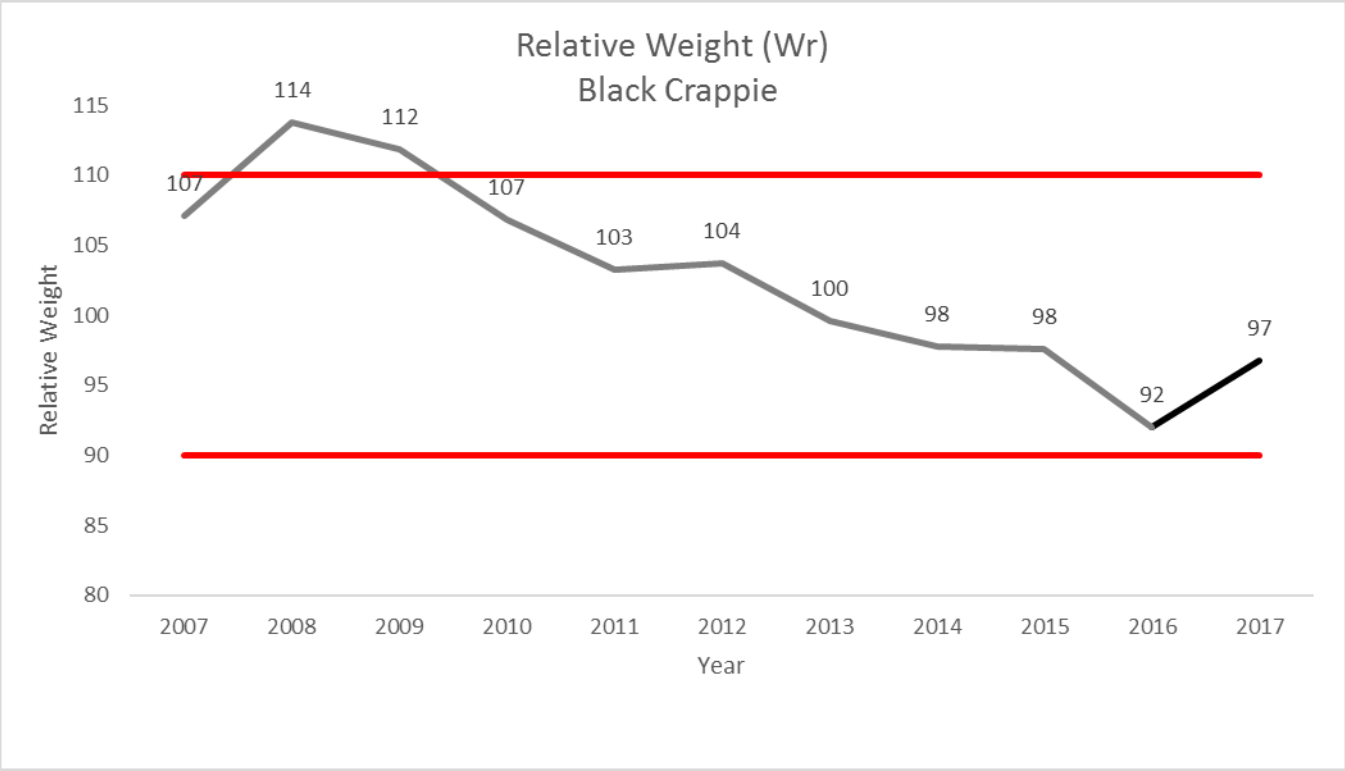


*Figure 15*

**KEA 15:** Feeding

**Indicator:** Distribution of abundant aquatic vegetation

**Desired Range:** 25-40% of the littoral area contains abundant vegetation during July-August

**Goal Met: YES**

Met: 2008-**2017**

Not met:

Not measured: 2007

**Notes:**

- Out of all littoral (≤1.5 m water depth) aquatic vegetation sites during July-August, contained aquatic vegetation 88% of the time this exceeds the desired range of 25-40% (Fig 16).

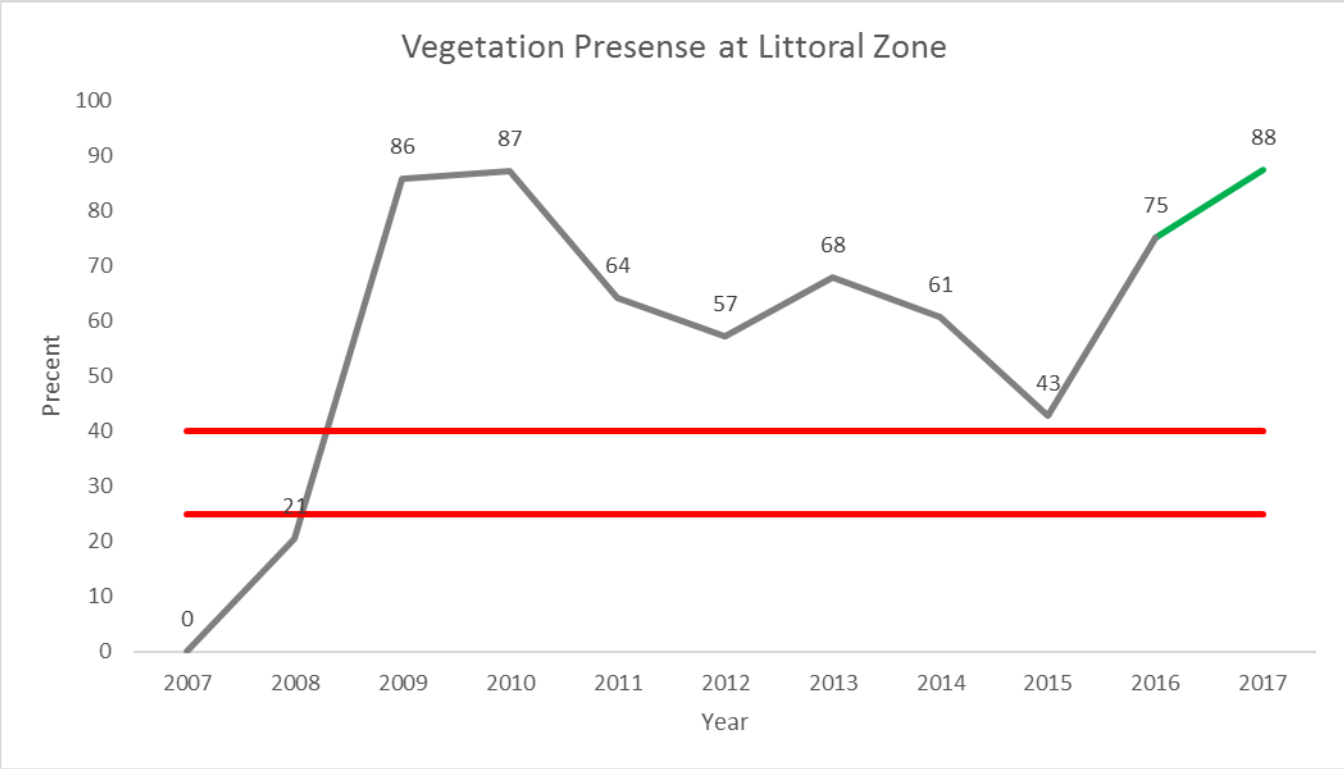


*Figure 16*

**KEA 16:** Over-wintering

**Indicator:** Percent of deep (oxygen rich) water

**Desired Range:** Water depth (5% >3 m, 10% 2-3 m, 25% 1-2 m, 60% <1 m); Dissolved oxygen (4.0-6.0 ppm at 2 m depth); Water temperature ≥1 °C (34 °F) at 2 m depth

**Goal Met: NOT MEASURED**

Met: 2011, 2013, 2014, and 2015

Not met:

Not measured: 2007-2010, 2012, 2016, and **2017**

**Notes:**

- The persistence of high numbers of native fish species across years provides indirect evidence that fish have been over-wintering successfully at the Emiquon Preserve.
- Winter fish sampling was not conducted in from 2007-2010 and 2012, 2014, and 2016-2017.

**KEA 17:** Over-wintering

**Indicator:** Presence of backwater species

**Desired Range:** Water temperature ≥34 °F based on the needs of freshwater drum (Bodensteiner & Lewis 1992)

**Goal Met: NOT MEASURED**

Met: 2013, 2014, and 2015

Not met:

Not measured: 2007-2012, 2016, and **2017**

**Notes:**

- Winter fish sampling was not conducted in from 2007-2010 and 2012, 2014, and 2016-2017.

**KEA 18:** Over-wintering

**Indicator:** Concentrations of over-wintering native species

**Desired Range:** Maximum electrofishing CPUE (hot spots) for wintering native species exclusive of gizzard shad *Dorosoma cepedianum* and minnows >1500 individuals/hr and >5 species (very good = >2000/hr)

**Goal Met: NOT MEASURED**

Met:

Not Met: 2013, 2015

Not measured: 2007-2012, 2014, 2016, **2017**

**Notes:**

- Winter electrofishing was not conducted in 2017.

**KEA 19:** Feeding
**Indicator:** Secondary production delivered to the river

**Desired Range:** Loading and timing of plankton, macroinvertebrates, and fish delivered to the river

**Goal Met: NOT MEASURED**

Met:

Not met:

Not measured: 2007-**2017**

**Note**:

- Although not quantified, secondary production likely occurred when an estimated of 3.1 billion gallons of water was released over a 50-day period. This began in mid-August and continued until October 5$^{th}$. This dropped the water level from approximately 433 ft asl to approximately 431 ft asl, exposing 1422 acres of land that was previously inundated.

# Publications

*Peer reviewed*

Lemke M. J., H. M Hagy, K. Dungey, A. F. Casper, A. M. Lemke, VanMiddlesworth, and A. Kent. 2017. Echoes of an Illinois River flood pulse: Short-term effects of the flood of record on two ecological restoration projects. Hydrobiologia (River Floodplain Restoration Special Iss.) DOI 10.1007/s10750-017-3220-5.

Lemke M. J., A. F. Casper, H. M. Hagy, and H. Chen. 2017 Floodplain Wetland Restoration along the Illinois River. Chapter 7 in Ecological Restoration in the Midwest: Putting Theory into Practice (Lenhart C. and R. Smiley, editors). Society for Ecological Restoration and Island Press.

*Poster Presentation*

Mendenhall, O.M., A. L. Whitten, and A. F. Casper. Preliminary Results of Electrofishing Emiquon' s Water Control Structure.2017. Mississippi River Research Consortium. La Crosse, WI April 2017.

Mendenhall, O.M., A. L. Whitten, and A. F. Casper. Preliminary Results of Electrofishing Emiquon' s Water Control Structure.2017. Emiquon Science Symposium. Lewiston, Illinois May 2017.

*Oral Presentation*

Mendenhall, O.M., D. K. Gibson-Reinemer, A. F. Casper. 2017.Accessing the Emiquon Fish Assemblage in the First Decade of Restoration. Emiquon Science Symposium. Lewiston, Illinois May 2017.

Gibson-Reinemer, D.K., O. M. Mendenhall, and A. F. Casper. 2017. Increasing Segregation in the Emiquon Fish Assemblage Over Time. Emiquon Science Symposium. Lewiston, Illinois May 2017.

*Technical Reports*

Mendenhall, O. M. and A. F. Casper. 2017. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring 2016 field report. http://hdl.handle.net/2142/90091

Mendenhall, O. M., D. K. Gibson-Reinemer, T. D. VanMiddlesworth, A. F. Casper. 2017. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring 9 Year (2007-2015) Report. http://hdl.handle.net/2142/96020

Mendenhall, O. M., J. A. DeBoer, A. K. Fritts, M. W. Fritts, R. M. Pendleton, L. E. Solomon, T. D. VanMiddlesworth, A. F. Casper. 2017. Estimating population size of largemouth bass and black crappie at The Nature Conservancy's Emiquon Preserve prior to reconnection to the Illinois River. http://hdl.handle.net/2142/95738

*Additional (Non-Monitoring) Fish Projects*

- **Assessing fish usage of Water Control Structure during operation and nonoperational periods**: Field sampling was conducted from June to September in 2017 once per month.

# Literature Cited


Havera, S. P., and L. L. Anderson. The Thompson Lake/Emiquon Story. Illinois Natural History Survey, 2003. Print.

Neumann, R. M., C. S. Guy, and D. W. Willis. 2012. Length, weight, and associated indices. Pages 637-670 in A. V. Zale, D. L. Parrish, and T. M. Sutton, editors. Fisheries Techniques, 3rd edition. American Fisheries Society, Bethesda, MD.

Pendleton, R. M., C. Schwinghamer, L. E. Solomon, and A. F. Casper. 2017. Competition among river planktivores: are native planktivores still fewer and skinnier in response to the Silver Carp invasion? Environmental Biology of Fishes 100(10):1213–1222.

Ratcliff, E. N., E. J. Gittinger, T. M. O'Hara, and B. S. Ickes. 2014. Long Term Resource Monitoring Program Procedures: Fish Monitoring, 2nd edition. A program report submitted to the U.S. Army Corps of Engineers' Upper Mississippi River Restoration-Environmental Management Program, June 2014. Program Report LTRMP 2014-P001, 88 pp. including Appendixes A–G, http://pubs.usgs.gov/mis/ltrmp2014-p001/.

VanMiddlesworth T. D., G. G. Sass, B. A. Ray, T. W. Spier, J. Lyons, N. N. McClelland and A. F. Casper. Food habits and relative abundances of bowfin, spotted gar, and largemouth bass: Implications for controlling common carp. Hydrobiologia (River Floodplain Restoration Special Issue, Online: 29 July 2016: 1 – 13). DOI: 10.1007/s10750-016-2866-8.

Yin, Y., J. S. Winkelman, and H. A. Langrehr. 2000. Long Term Resource Monitoring Program Procedures: Aquatic Vegetation Monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI.